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Service

Water Resource Report

For the Fourmile Vegetation Management Project

Eagle River-Florence RD

Chequamegon-Nicolet National Forest

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Executive Summary

In this report, I looked at how the proposed Fourmile project would affect aquatic resources. I determined activities associated with mechanical operations for timber harvest in addition to permanent road construction, road re-construction, and road decommissioning would not impair the long-term water quality.

Harvest area thresholds for peak snowmelt and storm flow runoff were identified using existing research regarding the effect of aspen clearcutting on stream flows in the Lake States. The analysis indicates that adverse impacts to hydrology and water quality are unlikely as a result of the proposed aspen clearcuts in alternative 2. The two selected watersheds located within the project area do not approach the thresholds for peak flows of snowmelt or rainfall runoff. Geographic Information System (GIS) was used to identify and calculate the total acreage of proposed treatment areas (by type) that are located within riparian management zones (RMZs). One hundred feet is the largest riparian management zone (RMZ); designated trout streams, (regardless of width), streams three feet wide and wider as well as lakes have a 100 ft. RMZ while streams less than three feet wide and streams less than one foot wide have a 35 ft. RMZ. The RMZ widths used in this analysis are identified in Wisconsin's Forestry Best Management Practice's (BMP) for Water Quality where management practices can be modified to protect water quality, fish and other aquatic resources (WDNR 2010). In summary, alternative 2 proposes up to 105 acres of RMZ harvest treatments where the desired future condition of the stand is to promote the growth and retention of long lived tree species appropriate to the site. There are no aspen stands proposed for clear cut harvest activities within the selected trout stream 300 ft. buffer zones.

In alternative 2, decommissioning of up to 0.03 miles of road located in RMZs, 2.33 miles in wetlands and one stream crossing removal would help to improve hydrologic functions by reducing sediment inputs and the potential effects from off-road vehicle use.

Based on my findings of minimal direct and indirect effects on water quality, I conclude that the effect to water quality from proposed activities would not impair the long-term water quality. These assumptions are based on the findings of past timber sales where the ground cover is maintained by residual vegetation and logging slash and areas where the soil is exposed, re-vegetation typically occurs fairly quick (USDA Forest Service 2001). In addition, since 1995 BMP monitoring has been completed across various land ownerships (State, County, Federal, and Industrial/ Private Lands to evaluate the success of the program. Overall, Federal sales monitored indicated 95% of the time BMPs were applied correctly where needed, see Appendix D *Implementation and Effectiveness of Wisconsin's Forestry Best Management Practices for Water Quality on the Chequamegon-Nicolet National Forest, 1995-2014*. Project design features, which include BMPs, when properly implemented would ensure that project activities would *not* cause long term impacts to water quality.

Introduction

This water resource effects analysis utilized all available aquatic ecological classification and inventory, water resource information, current research, and professional judgment of resource specialists. The effects of the alternatives proposed for this project area were assessed on a site-specific basis and project design features recommended to ensure the quality of the water resources within and adjacent to the analysis area are maintained. Some stands were deferred

because access would involve complicated wetland or stream crossings. Lakes, streams, ponds, riparian areas, and wetlands within and adjacent to proposed treatment areas have been identified, see Appendices A-E which provide an existing condition of the water resources as well as maps identifying those resources within the project area.

Concerns were raised that activities associated with timber harvesting including permanent road construction, temporary road construction, and road decommissioning may impact streams and other surface water bodies in the project area. Some believe logging and road building will generally increase peak flows and sediment loads in streams resulting in undesirable effects to down-stream aquatic resources. This analysis focuses on effects to peak flow from snowmelt runoff and rainfall runoff from harvest activities. Road activities as well as harvest activities located within riparian management zones and wetlands were identified.

The water quality of lakes and streams could be negatively affected as a result of Forest management activities if sedimentation were to occur. Erosion is the process by which soil particles are detached and transported. Erosion resulting from natural causes is referred to as geologic erosion, while that caused by human activities is commonly known as accelerated erosion (Hewlett and Nutter 1969). Erosion can be caused from water, wind, and gravity. In Wisconsin, water is the most common erosive agent, particularly in forested areas. When eroded material is transported and then deposited by water or wind, it is referred to as sediment and the process as sedimentation. Sediment yield is the amount of sediment transported from an area, usually from a watershed via a stream.

Accelerated erosion and sediment yield from timber harvest areas are typically minimal because good ground cover is maintained by residual vegetation and logging slash and because areas where soil is exposed tend to rapidly re-vegetate. Exceptions to this general rule include roads, skid trails, landings and recreational trails (Hewlett and Nutter 1969). Sediment yields in Wisconsin range from a high of 100-500 tons/sq mi/yr to a low of less than 10 tons/sq mi/yr (Hindall 1976; Hindall 1972; Hindall and Flint 1970). The highest sediment yields occur in the hilly terrain with mixed forest and agriculture in the southwestern part of the state and the red clay region near Lake Superior. The lowest yields occur in the forested areas of northern Wisconsin including the Chequamegon-Nicolet NF. These low yields occur for three reasons. First erosion and sediment yield from timber harvest areas is usually low because ground cover is often provided by residual vegetation, logging slash and rapid re-growth of vegetation (Very 1972; Spangenberg and McLennan 1983). Second, timber harvest and other forest management activities typically only impact a small portion of the area in any given year. For example, on the Chequamegon-Nicolet NF, timber harvest has occurred on 1.6 percent of the land each year over the last decade (USDA Forest Service 1998). Third, even when erosion does occur it frequently is not delivered to streams because of the low relief and undulating terrain (Verry 1972).

Sediment is recognized as the most important water pollutant in the United States in terms of total quantity (Oschwald 1972; Ritchie 1972) miles of stream affected (US EPA 1990), and adverse effects on aquatic communities (Judy et. al. 1984). Surface erosion from roads can introduce fine sediment to streams. Fine sediment is a particular water quality problem in streams because it can reduce: (1) available habitat by filling pools; (2) survival of fish eggs and fry; and (3) survival, composition and abundance of aquatic invertebrates (Waters 1995; Cordone and Kelly 1961). Sedimentation can also affect channel morphology by increasing width/depth ratio and reducing sinuosity (Rosgen 1994). Sand sediments in particular are associated with

increased width and reduced depth (Heede 1980). Potential effects on fisheries could occur as a result of changes in water quality or loss of habitat through direct stream disturbance or removal of potential sources of large woody debris.

Riparian ecosystems play a critical role in the health of aquatic ecosystems (streams, lakes, and ponds). Along streams, they provide shade to maintain cold or cool water temperatures. They provide the primary food source for headwater streams in leaf litter and detritus. They provide storage for floodwaters. Along lakes, streams and wetlands, riparian ecosystems act as filter strips to remove non-point water pollutants. They produce large woody debris that enhances aquatic habitat and when occupied by healthy vegetation, stabilize stream-banks and shorelines. Riparian ecosystems are also important wildlife habitats and recreation sites.

Relevant Laws, Regulations, and Policy

Regulatory Framework

Land and Resource Management Plan (Forest Plan)

The Chequamegon-Nicolet National Forest Land and Resource Management Plan (LRMP) provides standards and guidelines for water resources.

Guidelines for Watershed Protection include:

- Maintain water quality by following guidelines contained in "Wisconsin's Forestry Best Management Practices for Water Quality," (BMPs), 2010 edition
- Utilize the "Wisconsin Construction Site Best Management Practices Handbook" as well as the "Best Management Practices for Erosion and Sedimentation Control," (Federal Highway Administration) for guidance on limiting sedimentation.
- Ensure revegetation of log landings after project activities are completed, either through artificial means or natural revegetation.
- Utilize Wisconsin's Forestry BMPs to maintain soil productivity, infiltration rates and minimize road maintenance costs.

Standard for Riparian Areas include:

- Design and maintain roads and trails in riparian areas or other locations that could affect water quality, in accordance with Wisconsin's Forestry Best Management Practices. Road and trail surfaces within these areas will be stabilized with aggregate or other suitable material when being used during non-frozen conditions.

Guidelines for Riparian Areas include:

- Do not pile slash within or move slash into riparian areas. Keep slash out of lakes, stream channels, floodplains, and areas where it may be swept into streams, rivers, and lakes.
- Utilize Wisconsin's Forestry Best Management Practices (BMPs) for riparian management zone categories. Expand riparian management zones wider than those defined in Wisconsin's Forestry BMPs and modify management practices where necessary (e.g., projects on steep slopes and/or highly erodible soils).

- Protect warm and cold-water streams from sedimentation by maintaining the physical integrity of intermittent and non-navigable streams, i.e., streams that do not appear on 1:24,000 topographic maps to ensure their continued function when they do contain water.
- Provide and maintain conifer thermal cover within riparian areas.
- Avoid stream and wetland crossings and riparian areas when constructing new roads and trails.
- Relocate existing roads and trails out of riparian areas and eliminate stream crossings where practicable. Otherwise, construct or reconstruct roads, trails and associated stream crossings to minimize erosion, sedimentation and riparian impacts. Design culverts and bridges to pass the estimated 100-year flood.

Standard for Wetlands include:

- Protect hydrologic function and maintain natural hydrologic regimes.

Guidelines for Wetlands include:

- Utilize guidelines found in Wisconsin's Forestry BMPs to maintain water quality and hydrologic wetland functions during activities such as timber harvesting or road and trail construction.
- Minimize fill and maintain cross road drainage when wetland road and trail crossings cannot be avoided.

Guidelines for Woodland Ponds include:

Ephemeral ponds smaller than one acre:

- Do not operate heavy equipment in woodland ponds.
- Locate landings and roads to avoid erosion and the contribution of sediment into woodland ponds.
- Do not allow logging slash in woodland ponds. However, selected trees may be dropped and left in ponds where large woody debris would enhance aquatic habitat.
- Prohibit the operation of heavy equipment during non-frozen conditions within 15 feet of the normal high water mark.

Ephemeral ponds larger than one acre:

- Do not operate heavy equipment in woodland ponds.
- Locate landings and roads to avoid erosion and the contribution of sediment into woodland ponds.
- Do not allow logging slash in woodland ponds. However, selected trees may be dropped and left in ponds where large woody debris would enhance aquatic habitat.
- Prohibit the operation of heavy equipment during non-frozen conditions within 15 feet of the normal high water mark.
- Do not clearcut within 50 feet of the normal high water mark of these ponds. Individual tree timber harvesting may be done within this zone if there is an emphasis on retaining shade trees and large diameter cavity and nest trees adjacent to the pond.

Permanent woodland ponds smaller than one acre:

- Do not operate heavy equipment in woodland ponds.
- Locate landings and roads to avoid erosion and the contribution of sediment into woodland ponds.
- Do not allow logging slash in woodland ponds. However, selected trees may be dropped and left in ponds where large woody debris would enhance aquatic habitat.
- Prohibit the operation of heavy equipment during non-frozen conditions within 15 feet of the normal high water mark.
- Do not clearcut within 50 feet of the normal high water mark of these where they are uncommon (less than one per 10 acres). Where they are common, do not clearcut within 50 feet of at least one-third of the ponds. Individual tree timber harvesting can be done within this zone if there is an emphasis on retaining shade trees and large diameter cavity and nest trees adjacent to the pond.

Permanent woodland ponds larger than one acre:

- Use "Wisconsin's Forestry Best Management Practices for Water Quality" (2010 version) including Riparian Management Zone direction, for guidance on protection.

Standard for Fisheries Habitat Management include:

- Maintain a minimum of 80% shrub or tree shade (where present) around ground water seeps within cool and cold water systems.

Guidelines for Fisheries Habitat Management include:

- Manage riparian areas so that they contribute large woody debris (LWD) to lakes, ponds, rivers, and streams. LWD characteristics include: (1) At least 10 to 30 pieces per 1,000 feet of shoreline adjacent to uplands, and at least 5 to 20 pieces per 1,000 feet of shoreline adjacent to forested lowlands; (2) Most pieces greater than 12 inches in diameter and some resistant to decay; (3) Many pieces in lakes with strong branches on the boles which hold part of the wood off the bottom; (4) LWD length should be at least 50 to 120 feet long in lakes and wide streams, or a length that is 1 to 2 times bankfull width in narrow-medium width streams (i.e. less than 50 ft. wide).

Standard for Aspen and Beaver Management include:

- Aspen patches will also not be regenerated within 300 feet of all other Class I and II trout streams including their tributaries and spring ponds. Those streams include Ninemile Creek, North Branch Pine River, and Spring Meadow. Manage vegetation within these zones for species other than aspen, preferably long-lived conifers and northern hardwoods.

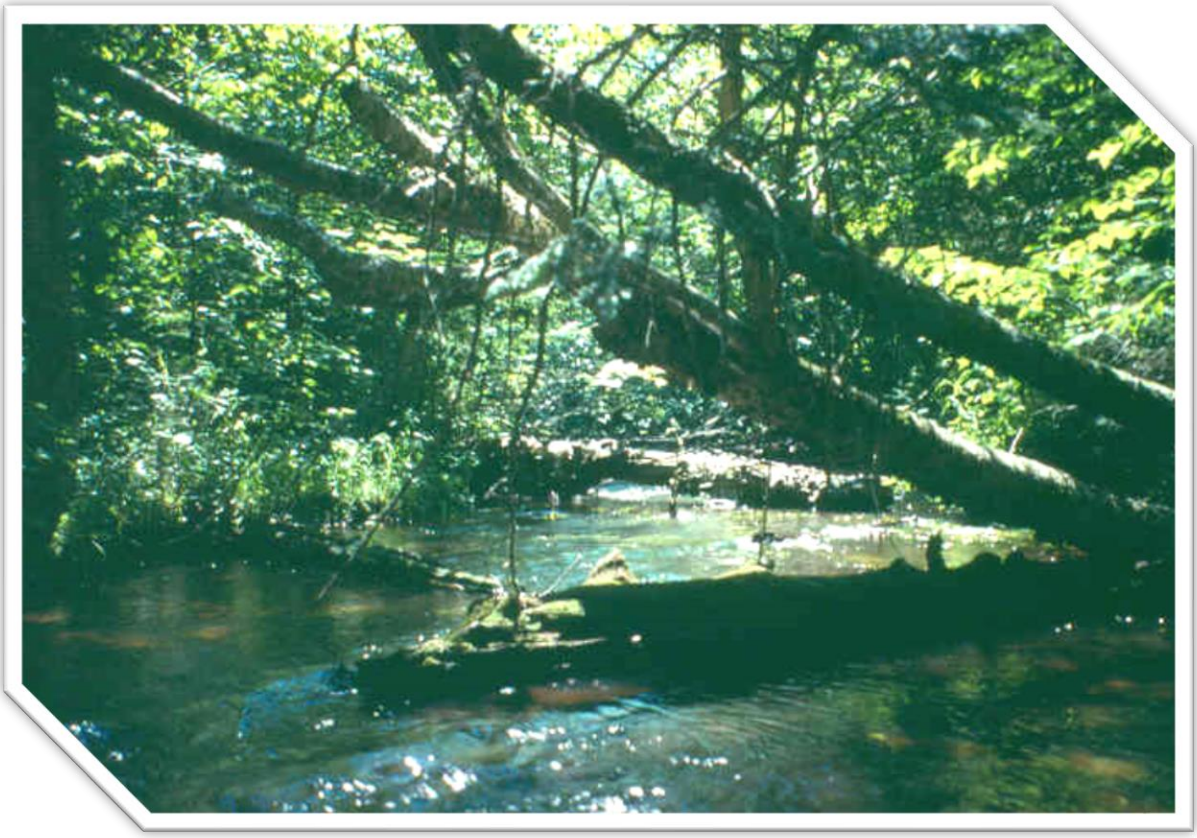
Guidelines for Fisheries Habitat Management include:

- Convert from aspen to long-lived conifers and northern hardwoods within 300 feet of all Class I and II trout streams (and their tributaries including spring ponds) (see streams listed in standard above).

Desired Condition

A desired condition for riparian corridors bordering streams and lakes is that their structure, function, and composition are intact and serve as landscape connectors. To maintain appropriate riparian structure and function, the upland terrestrial component of riparian areas should be managed for tree species diversity, large long lived, tall trees appropriate for the site that provide shade, detritus, large woody debris, shoreline and bank stability and overhead cover.

Image 1. Desired Riparian Composition with Overhanging Trees



Among other things, this would provide for terrestrial wildlife habitat, long term large woody debris recruitment to aquatic and terrestrial portions of riparian areas, soil and bank stability, water temperature control, and riparian area microclimate moderation. Desirable species include white and red pine, hemlock northern white cedar and to a lesser extent white spruce, red oak, sugar maple and red maple (CNNF LMRP, p. 2-17).

A desired condition for wetlands is that the diversity and abundance of wetlands are maintained over time. Natural hydrological regimes are maintained for a variety of wetland types (CNNF LMRP p. 3-59).

Most class I and II trout streams are in a free-flowing condition which provides suitable habitat for coldwater community (CNNF LMRP, p. 3-60).

Reduce the number of road and trail stream crossings. Reduce sedimentation, improve fish passage in existing road, and trail stream crossings (CNNF LMRP, p. 1-3, obj. 1.3a). Improve and restore aquatic/riparian habitat in streams and lakes (CNNF LMRP, p. 1-3, obj. 1.3e).

Management Area

Within the Fourmile project area the North Branch Pine River is designated as state Wild River. This state of WI designation includes a 150 foot "protection zone" managed to maintain and enhance a wild and natural condition which extends 150 feet back from the river's edge or to the visual horizon, whichever is greater. Lands more than 150 feet from the rivers are managed for forestry production, wildlife, and public recreational purposes. Except for road crossings, motorized vehicle access is restricted to designated areas outside of the protection zone. In addition, this river segment is designated as National Eligible Scenic River. The Chequamegon-Nicolet National Forest Land and Resource Management Plan (LRMP) provides standards and guidelines for management adjacent to this river. Vegetation management standards and guidelines for 8D include:

Standard for Management Area 8D- Designated State Wild River and Eligible National Scenic River:

- Timber harvesting can occur within scenic segments for the purpose of restoring or enhancing fish and wildlife habitat, visual quality, forest health, tree vigor, and long-lived large diameter trees. Even-aged management practices will not be visible from any point on the river and will not be permitted within 200 feet of river shorelines. Even-aged management practices will not be visible from any point on the state designated wild status and will not be permitted within 400 feet of river shorelines.
- Allow all silvicultural harvesting techniques within recreation segments (except clearcutting is not permitted where it is visible from the river). Timber harvesting within areas visible from the river will be for the purpose of restoring or enhancing fish and wildlife habitat and visual quality. *Timber harvests will be designed to create a large-tree character, and a species composition that favors long-lived, large diameter trees.*

Guideline for Management Area 8D- Designated State Wild River and Eligible National Scenic River:

- Timber harvesting within 150 feet of the river will be for the purpose of establishing long-lived, large diameter trees such as white pine, red pine, hemlock, northern white cedar, white spruce, and to lesser extent red maple, red oak, and sugar maple.

Federal Law

Clean Water Act (CWA) - establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

- Section 404 - establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands.
- Section 401 - State Certification of Water Quality
- Section 208 of the 1977 Clean Water Act required states to develop plans and procedures to control non-point sources of pollution, including silvicultural sources, to the extent

Section 319 of the 1987 Water Quality Act requires each state to develop and implement a program to reduce non-point source pollution to the "maximum extent practicable." The act requires that BMPs be used to control non-point sources of water pollution. Wisconsin's forestry best management practices for water quality development process began in the late 1980's and early 1990's.

National Forest Service Manual and Handbook Direction for Watershed and Air Management- 2522- Watershed Improvement, 2524 Support, 2525 Monitoring, 2526 Riparian Area Management, 2527 Floodplain Management and Wetland Protection, and 2532 Water Quality Management.

Executive Orders

Protection and Enhancement of Environmental Quality, EO 11514 of March 5, 1970

Protection of Wetlands, EO 11990 of May 24, 1977

Floodplain Management, EO 11988 of May 24, 1977

State and Local Law

Department of Natural Resources Administrative Code

- Chapter 102 Water Quality Standards For Wisconsin Surface Waters
- Chapter 103 Water Quality Standards for Wetlands
- Chapter 302 Management of Wisconsin's Wild Rivers

Other Guidance or Recommendations

Since inception of the Wisconsin's Forestry BMP voluntary program in 1995, the use and effectiveness of BMP's across all land ownerships in Wisconsin, including the National Forest, has been monitored by interdisciplinary and interagency teams, during the years of 1995 to 2015. Each year a different land ownership type (State, Private, Industrial, County or Federal) is monitored. Annual monitoring involvement by the Forest Service helps the state implement the program and meet requirements identified in the Clean Water Act and Water Quality Act.

Topics and Issues Addressed in This Analysis

Purpose and Need

One of the purpose and needs for the project includes: Maintain or restore vegetation communities to their desired conditions in Management Areas 2A, 2B, and 4B (Forest Plan Objective 1.4a)

- Improve age class distribution, moving stands toward desired conditions
- Increase forest health to reduce probability of widespread insect and disease outbreaks
- Maintain or move northern hardwood stands toward an uneven-aged condition consistent with the Forest Plan direction while maintaining or enhancing within stand species diversity

- Improve tree species composition to more closely reflect Forest Plan desired conditions

This purpose and need works towards meeting Forest Plan objective 1.3e. Improve or restore aquatic/riparian habitat in streams and lakes. The goal is to provide for ecologically healthy streams, riparian areas and lakes (LRMP 1-2).

Issues

Concerns were raised that activities associated with mechanical operations for timber harvest in addition to permanent road construction, temporary road construction, and road decommissioning may impact streams and other surface water bodies in the project area. Some believe logging and road building will generally increase peak flows and sediment loads in streams resulting in undesirable effects to down-stream aquatic resources.

The water quality of lakes and streams could be negatively affected as a result of Forest management activities if sedimentation were to occur. Erosion is the process by which soil particles are detached and transported. Erosion resulting from natural causes is referred to as geologic erosion, while that caused by human activities is commonly known as accelerated erosion (Hewlett and Nutter 1969). Erosion can be caused from water, wind, and gravity. In Wisconsin, water is the most common erosive agent, particularly in forested areas. When eroded material is transported and then deposited by water or wind, it is referred to as sediment and the process as sedimentation. Sediment yield is the amount of sediment transported from an area, usually from a watershed via a stream.

Accelerated erosion and sediment yield from timber harvest areas are typically minimal because good ground cover is maintained by residual vegetation and logging slash and because areas where soil is exposed tend to rapidly re-vegetate. Exceptions to this general rule include roads, skid trails, landings and recreational trails (Hewlett and Nutter 1969). Sediment yields in Wisconsin range from a high of 100-500 tons/sq. mi/yr. to a low of less than 10 tons/sq. mi/yr. (Hindall 1976; Hindall 1972; Hindall and Flint 1970). The highest sediment yields occur in the hilly terrain with mixed forest and agriculture in the southwestern part of the state and the red clay region near Lake Superior. The lowest yields occur in the forested areas of northern Wisconsin including the Chequamegon-Nicolet NF. These low yields occur for three reasons. First erosion and sediment yield from timber harvest areas is usually low because ground cover is often provided by residual vegetation, logging slash and rapid re-growth of vegetation (Very 1972; Spangenberg and McLennan 1983). Second, timber harvest and other forest management activities typically only impact a small portion of the area in any given year. For example, on the Chequamegon-Nicolet NF, timber harvest has occurred on 1.6 percent of the land each year over the last decade (USDA Forest Service 1998). Third, even when erosion does occur it frequently is not delivered to streams because of the low relief and undulating terrain (Verry 1972).

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ratio and reducing sinuosity (Rosgen 1994). Sand sediments in particular are associated with increased width and reduced depth (Heede 1980). Potential effects on fisheries could occur as a result of changes in water quality or loss of habitat through direct stream disturbance or removal of potential sources of large woody debris.

Riparian ecosystems play a critical role in the health of aquatic ecosystems (streams, lakes, and ponds). Along streams, they provide shade to maintain cold or cool water temperatures. They provide the primary food source for headwater streams in leaf litter and detritus. They provide storage for floodwaters. Along lakes, streams and wetlands, riparian ecosystems act as filter strips to remove non-point water pollutants. They produce large woody debris that enhances aquatic habitat and when occupied by healthy vegetation, stabilize stream-banks and shorelines. Riparian ecosystems are also important wildlife habitats and recreation sites.

Resource Indicators and Measures

The potential effect of proposed aspen clearcutting on hydrology was evaluated by determining the amount of existing open area landscape condition for two 6th level watersheds with the highest percentage of Forest Service land ownership within the watershed. Proposed clear cut and coppice type harvest activities were calculated for each watershed. The open areas were calculated and compared to thresholds for potential increases in peak snowmelt and storm flow runoff that could affect stream channel morphology, sediment yield and aquatic habitat. The selected thresholds were greater than 60 percent of a watershed in an open condition (forest less than 15 years old, non-forest upland, non-forest wetland) for snowmelt runoff and greater than 35 percent upland in an open condition for storm flow runoff (forest less than nine years old, non-forest upland) (Verry et al. 1983).

In addition, total acres of harvest activities located within the RMZs were calculated. Riparian harvest activities proposed help to achieve the desired future condition to maintain tree species diversity, large long lived, tall trees appropriate for the site that provide shade, detritus, large woody debris, shoreline and bank stability and overhead cover.

Roads can disrupt aquatic systems in a variety of ways, particularly at stream crossings, roads within riparian areas and roads through wetlands. Culverts can be undersized resulting in frequent washouts, ponding upstream, poor fish passage, and habitat degradation. Roads that cross wetlands can result in changes in the wetland hydrology, particularly when there is not adequate cross drainage. The total number of stream crossings proposed to be removed and length of roads that cross through wetlands proposed for decommissioning was calculated for each alternative.

Table 1. Resource indicators and measures for assessing effects

Resource Element	Resource Indicator	Measure (Quantify if possible)	Used to address: P/N, or key issue?	Source
Peak Flow- Snowmelt Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <15 yrs. old+ non-forest upland+ non-forest wetland)	Issue: Water Quality Impacts	Verry et al. 1983
Peak Flow- Storm Flow Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <9 yrs. old+ non-forest upland)	Issue: Water Quality Impacts	Verry et al. 1983
RMZ Vegetation Management	Large Woody Debris future recruitment	Acres of riparian treatments to promote long lived species	Purpose and Need A. Need to improve/maintain forest health	CNNF LMRP, p. 2-17
Road Activities in RMZs and Wetlands	Sediment delivery	# of stream crossings removed or length of road wetland crossings removed	Issue: Water Quality Impacts	CNNF LRMP, p. 2-2

Methodology

Forest Service stand data was used to identify the proposed clearcuts and estimate existing or potential future openings. Proposed aspen clearcut harvests located within two watersheds that have the most Forest Service land ownership with the highest concentration of harvests was used in this analysis. It represents the potential worst case scenario within the project area. The potential effect of proposed aspen clearcutting on hydrology was completed by identifying the permanent openings using Forest vegetation layer, forest stand layer and private lands layer. Forest Service stand data was used to identify the proposed clearcuts and estimate existing or potential future openings. It was also used to identify forested and nonforested open area (forested wetland = FS stand type 12, 14,15,18,19 and nonforested = 97, 98, 99) on NF lands. Private lands layer (FDDS) classifications of lowland opening, upland opening, agriculture, urban, clearcut and water were used to determine open areas.

The existing and potential openings include aspen stands that have been harvested or planned for harvest since 2003. For snowmelt runoff, clearcuts (<15 yrs.), non-forest upland and non-forest wetland were considered open. For storm flow runoff, clearcuts (<9 yrs.) and non-forest upland was considered open.

This analysis represents a reasonable estimate of the amount of open canopy in the select 6th level watersheds and the potential for timber harvest to affect peak flows. They do not provide a precise measure of the exact acreage in an open condition for any given year. To do so would require knowing the exact year each existing or potential stand would be harvested. This would allow an accurate accounting of both new openings and those that had recovered to the point where they would have no effect (i.e., stands greater than nine or 15 years old) on peak flows. Such detailed estimates are not possible for some temporary openings and require a substantial amount of time for others. For example, timber sale purchasers normally have up to five years to

harvest National Forest timber. This represents one-half to one-third the recovery period for clearcut harvest effects on peak flows. In the case of timber harvest on other lands in the watershed, it might be possible to determine when timber was harvested on other lands but it can be very time consuming and it might not be possible to predict or estimate future timber harvests. So while at the 6th level watershed scale some temporary forest openings may have been missed by the analysis, it is equally likely that many of the identified and missed temporary openings would recover by the time the proposed clearcuts in the Fourmile project are actually harvested. It is less likely that any temporary openings were missed for the select 6th level watersheds but is likely that some of the identified temporary forest openings will recover before any of the proposed clearcuts take place.

Information Sources

Research conducted in the Lake States regarding the effects of aspen timber harvest on hydrology and water quality indicates that potential effects on water quality and hydrology are unlikely. Impacts to water quality are minimal when upland sites are clearcut using good land management practices (Verry 1972; Spangberg and McLennan 1983). In recent years, monitoring of Wisconsin's Forestry Best Management Practices (BMPs) for water quality has drawn similar conclusions (Shy and Wagner 2007).

Clearcutting aspen in the Lake States can increase streamflow from the harvest area by 3.5 inches or 40 percent the first year following harvest (Verry 1986). This increase occurs primarily from June through October. If the stand regenerates to aspen, the increase will decline to zero in 12-15 years as the new stand grows and uses more water via evapotranspiration.

Aspen clearcutting causes peak flow rates to increase but the nature of the response depends on whether the runoff event is caused by snowmelt or rainfall. Snowmelt peaks can increase 11 to 143 percent from the harvest area but snowmelt volumes do not change (Verry et al. 1983). The increase in peak flows results from an earlier (about five days), more rapid melt in the harvested area. This occurs because differences in elevation and slope-aspect tend to be minor in the Lake States. This causes the difference between open and forest canopy to become a major determinant of the amount of solar energy available for melt at the snow surface. Harvesting up to 60 percent of a watershed results in a decrease in the snowmelt peak because snowmelt from mature and young forest is desynchronized. This can reduce snowmelt flood peaks by 30 percent. Verry (2000) concluded that other open land such as agricultural fields produces a similar result in the Lake States. It is seems reasonable to assume that non-forested wetland might also melt at the same time as other open areas. If the area harvested or in an open condition exceeds 60 percent of a watershed, then snowmelt peaks can double as the earlier, more rapid melting is synchronized throughout a watershed.

Clearcutting 71 percent (the entire upland) of a small watershed (84 acres) caused rainfall peaks to double but the effect only lasted three to five years and peaks during a period 6-9 years after harvest were not significantly different from the control watershed (Verry et al. 1983). Runoff volume from rainstorms increased up to 170 percent but returned to pre-harvest levels in three years. These increases can be attributed to higher soil moisture resulting from lower evapotranspiration following harvest and a subsequent decrease in available water storage in the clearcut area.

Increases in peak flows caused by timber harvesting for both snowmelt and rainfall are limited to more frequent flood events. Major flood peaks are generally not affected by timber harvest because the volume of runoff far exceeds the volume of soil water storage that is affected by timber harvest and subsequent changes in evapotranspiration losses. Therefore, increases in peak flow rates caused by timber harvesting are generally limited to floods with recurrence intervals less than 25-years (Verry 2000).

A primary concern with increasing peak flows is that it can lead to channel widening, subsequent increases in sediment transport and reduced aquatic habitat. Since the channel forming flow is generally considered to be the 1.5-year flood, timber harvesting that increases this peak flow rate could cause stream channels to widen, increase downstream sedimentation as channel widen to accommodate the higher bankfull flow and these both could degrade in-stream aquatic habitat.

The potential effect of aspen clearcutting on peak flows is a function of the proportion of a watershed that is harvested or in an open condition at any point in time. For snowmelt, this would include forest stands less than 16-years old, permanent upland openings and non-forested wetland such as sedge meadow, open bog and shrub swamp. The recommended threshold where peak flows from snowmelt would begin to increase to the point where they could adversely affects stream channels, water quality (i.e., sediment) and aquatic habitat is 60 percent or more of a watershed (Verry 2000).

For rainfall runoff, open area would include forest stands less than 9-years old and permanent upland openings. There is no clear consensus regarding a threshold for storm runoff because additional factors can confound the response. These include the potential effects of soil compaction, the location of harvest areas relative to runoff source areas, and possible de-synchronization of peak flows can as watershed size increases. The potential for compaction will vary by soil type and timing of harvest (i.e., dry or frozen). Since harvesting 71 percent of a watershed caused peak storm flows to double the first few years following clearcut timber harvest, recover to pre-harvest conditions is relatively rapid and occurs within six to nine years and the Forest has mitigation measures to minimize compaction, a threshold of 35 percent of the watershed would provide reasonable protection from adverse increases in peak storm flows.

Spatial and Temporal Context for Effects Analysis

Direct/Indirect Effects Boundaries

The spatial boundaries for analyzing the direct and indirect effects to water resources is the Fourmile project area. The Riparian Management Zones (RMZ) as identified in Wisconsin's Forestry BMPs for Water Quality manual will be looked at in detail. The RMZ is an area where management practices are modified to protect water quality, fish, and other aquatic resources. Vegetation treatment areas with boundaries within 100 feet of the water resources were considered in this analysis. One hundred feet is the largest riparian management zone (RMZ); designated trout streams, (regardless of width), streams three feet wide and wider as well as lakes have a 100 ft. RMZ while streams less than three feet wide and streams less than one foot wide have a 35 ft. RMZ. The temporal boundaries for analyzing the direct and indirect effects are consistent with criteria used with WDNR BMPs for water quality monitoring program. Long-term effects are those expected to last longer than 1 year after treatment or mitigation is

completed, while those expected to last less than 1 year were considered short-term. Short term effects would be expected to occur during the first growing season or the time it takes exposed soil to become stabilized and re-vegetated. Long term effects would be expected to occur in subsequent growing seasons, where the short term effects were more prominent on the landscape and it will take longer for the sediment to flush downstream. Boundary distances and long verses short term effects criteria were chosen to be consistent with Wisconsin's Forestry BMP's for Water Quality Monitoring program. Although no quantitative thresholds for water quality are defined in the Forest Plan, it implies a general, forest-wide protection to provide for ecologically healthy streams, riparian areas, lakes and wetlands. These standards specifically require protection of hydrologic function and maintenance of natural hydrologic regimes in aquatic ecosystems as well as to design and maintain activities that could affect water quality in accordance with Wisconsin's BMP's (LRMP p.2-1 thru 3). An effect to water quality would exceed the threshold if long term impacts would occur. Short term effects would not exceed the threshold.

Cumulative Effects Boundaries

The water resources within the project area were also looked at from a watershed scale to assess potential cumulative effects. There are ten 6th level hydrologic unit code system (HUC) watershed boundaries that lie within and outside the project area (see Appendix B- 6th level HUC Watershed Map). These boundaries were chosen because this watershed size will provide the most comprehensive boundary when analyzing the cumulative effects to water quality from the proposed treatments. Included, are the potential effects from on-going projects occurring on Forest Service lands, State of WI managed lands and other private lands. These project boundaries overlap the Fourmile Project area as well as the cumulative effects boundary. Sediment movement downstream can be variable and dependent upon the landform characteristics. Potential effects on peak flows as a result of the proposed harvest activities evaluated potential snowmelt runoff and storm flow runoff within the two selected HUC 6 watersheds.

Affected Environment

Existing Condition

The Fourmile project area encompasses 55,279 acres. The existing condition of the aquatic resources was looked at from a watershed scale. The standard watershed map system used by State and Federal agencies consists of multiple levels referred to as the Hydrologic Unit Code (HUC) system. The 1st level is the largest scale of watershed mapping and each 1st level watershed has been sub-divided into smaller 2nd level watersheds. Watersheds in each mapping level are progressively subdivided into smaller watershed mapping levels (NRCS 2008). This analysis utilized the 6th level HUC sub-watersheds, where on average, all delineated 6th level watersheds within the project area encompass approximately 10,000 to 40,000 acres. For overview maps of these watersheds, refer to the map in Appendix B, *6th level HUC Watersheds*. Table 2 below lists the acreage for each watershed and their land ownership.

The total acres of non-forest upland acres and non-forest wetland acres is shown in table 2 for the select watersheds. These acreages are used calculate the open area for snowmelt runoff and storm flow runoff.

Table 2. HUC 5 Watersheds within the Fourmile Project Area

HUC 6 Watershed	Total Acres	USFS Acres in Project Area (% of HUC)	Private Acres in Project Area (% of HUC)	Riparian Acres *(RMZs acres for lakes and streams)*	Non-Forest Upland Acres	Non-Forest Wetland Acres	Open Snowmelt (%) *Non-forest Upland +Non Forest Wetland*	Open Rainfall (%) *Non-forest Upland*
Ninemile Creek-Eagle River	**18292**	**11959 (65%)**	**2878 (16%)**	**2500**	**1514**	**1733**	**3457 (19%)**	**1514 (8%)**
Headwaters-Eagle River	23686	10294 (43%)	673 (3%)	336				
Julia Creek	**10027**	**4206 (42%)**	**2986 (30%)**	**1184**	**993**	**864**	**2695 (27%)**	**993 (10%)**
Three Lakes Chain of Lakes-Eagle River	28058	7764 (28%)	2689 (10%)	1614				
North Branch Pine River	22319	3935 (18%)	1734 (8%)	1439				
Headwaters Wolf River	14172	1593 (11%)	3 (.02%)	9				
McDonald Creek-Pine River	33017	2482 (8%)	0	64				
Eagle River Chain of Lakes-Eagle River	20894	1208 (6%)	152 (1%)	58				
Blackjack Creek	10300	472 (5%)	40 (0.39%)	0				
Brule Creek	25492	155 (1%)	51 (.20%)	0				
				7204				

A variety of stream types occur within the project area. Streams within the Forest have been classified using two classification systems; Wisconsin Department of Natural Resources Trout

Class (WDNR 2002) and the Chequamegon-Nicolet Stream Classification System (USDA FS 2004). Appendix A, *Fourmile Existing Condition*, lists the streams and their classification types as well as a description of the Chequamegon-Nicolet Stream Classification System. See Appendix C, *Water Resources within Fourmile* for a map of the water resources within the project area.

There are two Class 1 trout streams within the project area, they include: Ninemile Creek and Spring Meadow. And three Class II trout streams; Kimball Creek, North Branch Pine River and Fourmile Creek.

The North Branch Pine River is designated by the state of Wisconsin as a state wild river. The area considered for special management along state wild rivers is 400 feet either side of the river. Typically the area visible from the river is less than the corridor width (LRMP 3-42, 43). In addition, North Branch Pine River is also designated as a candidate national scenic river that is eligible for designation by Congress. The CNNF LRMP designates a ½ mile wide river corridor where the area visible from the river is an important management consideration. See Appendix C, *Water Resources within Fourmile,* for a map showing the location of the river.

While these rivers have good to excellent water quality and are in a free-flowing relatively undisturbed condition, historical logging and log drives has impacted all of them. Logging at the turn of century and sometimes later also resulted in the removal of mature trees adjacent to rivers that would have served as future sources of large woody debris. Log drive associated activities clearly caused the most substantial impact by altering instream habitat and increasing erosion and sedimentation. These activities included the cleaning or improving of small rivers and streams so that logs could be floated downstream, the creation of log rollways, the construction of dams, and the log drives themselves. River cleaning included the cutting of brush and trees on the sides; digging cutoff channels between oxbows; and removing logs, rocks, and shoals from the channel by snagging or blasting. These activities would have resulted in some bed and bank erosion and a wider, cleaner channel susceptible to additional erosion. They also resulted in the loss of aquatic habitat through the removal of large rocks and vast amounts of large woody debris (LMRP 3-44).

Of the 44, 067 acres of National Forest System (NFS) lands in the project area, there are approximately 7204 RMZ acres. Due to the extensive timber harvests of the late 1800s/early 1900s, recent (within the past several decades) red pine plantation management activities within riparian areas and natural disturbances such as beaver activity have created a general lack of large, mature long-lived trees and/or tree species diversity in some riparian areas. Because of this past activity most of the riparian areas across the forest are relatively young with over ½ the upland acres in short lived species (Forest Plan FEIS, p. 3-9).

The continued regeneration of early succession species like aspen within the riparian area has resulted in providing ample supplies of the preferred food source for beaver. Beaver can adversely affect trout habitat by blocking migration, reducing shade through flooding, increasing water temperature, causing sedimentation of spawning areas and altering habitat which causes increased competition from other fish species (USFS 2002). The Forest has over 1200 miles of stream designated as trout water. Significant efforts have been made over the last two decades to restore the coldwater community, particularly to maintain free-flowing conditions. Part of this effort has been to reduce the amount of aspen next to trout streams to discourage beaver activity within those streams. Refer to Appendix A, *Fourmile Existing Condition*, for complete listing of

streams where aspen will not be regenerated within 300 feet. There are no aspen stands proposed for clear cut harvest activities within the selected trout stream 300 ft. buffer zones.

There are 34 named lakes within the project area. Refer to Appendix A, *Fourmile Existing Condition,* for a complete list of lakes within the project boundary. See Appendix C, *Water Resources within Fourmile,* for a map of the water resources within the project area.

According to the U.S. Fish and Wildlife National Wetland Inventory, there are a total of 15,631 acres of wetland within the project area (28% of project area), see Appendix C for a map of the water resources within the project area. This does not include all small isolated wetlands within the project boundary as some wetlands are very small and they are not easily identified. Wetlands are those areas that are inundated by surface or ground water with frequency sufficient to support, under normal circumstances, vegetation or aquatic life that requires saturated or seasonally saturated, soil conditions for growth and reproduction (FSM 2527.05 page 23). The types of wetlands found within the project area are listed in Table 3.

Table 3. Fourmile Wetland Types

Wetland Class	***Acres***
Emergent Wetland	572
Forested Shrub Wetland	14,755
Riverine Wetland	89
Pond	215
Total	*15,631*

The Forest land base including the project area has many roads. Many of these road corridors have been in place since the early logging days. Roads can disrupt aquatic systems in a variety of ways, particularly at stream crossings, roads within riparian areas and roads through wetlands. Culverts can be undersized resulting in frequent washouts, ponding upstream, poor fish passage, and habitat degradation. Roads that cross wetlands can result in changes in the wetland hydrology, particularly when there is not adequate cross drainage.

Table 4. Resource indicators and measures for the existing condition

Resource Element	Resource Indicator (Quantify if possible)	Measure (Quantify if possible)	Existing Condition	
Peak Flow- Snowmelt Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <15 yrs. old+ non-forest upland+ non-forest wetland)	Julia Creek 27%	Ninemile Creek- ER 19%
Peak Flow- Storm Flow Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <9 yrs. old+ non-forest upland)	Julia Creek 10%	Ninemile Creek- ER 8%
RMZ Vegetation Management	Large Woody Debris future recruitment	Acres of riparian treatments to promote long lived species	7204 acres located in RMZs available for riparian treatment	
Road Activities in RMZs and Wetlands	Sediment delivery	# of stream crossings AND length of road wetland crossings	• 21 existing road stream crossings • 11 miles of roads located within mapped wetlands	

Peak Flow- Snowmelt Runoff

The percent of existing open area within the two watersheds used to calculate snowmelt runoff ranges from 19-27%. The recommended threshold where peak flows from snowmelt would begin to increase to the point where they could adversely affects stream channels, water quality

(i.e., sediment) and aquatic habitat is 60 percent or more of a watershed (Verry 2000). The percentages found are well below the 60% threshold.

Peak Flow- Storm Flow Runoff

The percent of existing open area within the two watersheds used to calculate storm flow runoff ranges from 8-10%. A threshold of 35 percent of the watershed would provide reasonable protection from adverse increases in peak storm flows and the percentages found are well below the 35% threshold (Verry 2000).

RMZ Vegetation Management

There are approximately 7204 acres within RMZs. Some of these acres include acres of non-forested wetlands located within the RMZs where no vegetation management would occur.

Road Activities in RMZs and Wetlands

There are 21 existing road stream crossings and 11 miles of road that cross through mapped wetlands.

Environmental Consequences

Alternative 1 – No Action

There would be no effects to peak flow as landscape conditions would remain unchanged.

If the proposed RMZ under planting activities or RMZ vegetation management activities to promote the growth and vigor of the existing long lived species would be not implemented, the long term health of the riparian areas may be effected. The riparian under plantings would involve planting long lived conifer tree species. Overtime, these untreated areas would naturally convert to less desirable species that may not be favorable to the long term health of the riparian ecosystem. A desired future condition for riparian corridors consist of large long-lived, tall trees appropriate for the site that provide shade, detritus, large woody debris, shoreline and bank stability and overhead cover. Riparian areas provide large woody debris for the aquatic and terrestrial portions of the riparian area, soil and bank stability, diverse and productive sites for aquatic and terrestrial plants and animals. Maintaining healthy riparian ecological function provides for macroinvertebrate and fish habitat as well as stable banks and channel morphology for water quality.

Roads that are hydrologically connected to wetlands and streams would not be decommissioned. These roads may contribute sediment or alter the hydrologic function of the connected wetlands and streams.

Table 5. Resource indicators and measures for Alternative 1- No Action

Resource Element	Resource Indicator (Quantify if possible)	Measure (Quantify if possible)	Alternative 1- No Action	
Peak Flow- Snowmelt Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <15 yrs. old+ non-forest upland+ non-forest wetland)	Julia Creek 27%	Ninemile Creek- ER 19%
Peak Flow- Storm Flow Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <9 yrs. old+ non-forest upland)	Julia Creek 10%	Ninemile Creek- ER 8%
RMZ Vegetation Management	Large Woody Debris future recruitment	Acres of riparian treatments to promote long lived species	0 acres	
Road Activities in RMZs and Wetlands	Sediment delivery	# of stream crossings removed or length of road wetland crossings removed	0 crossings and 0 miles of wetland road crossings	

Alternative 2- Proposed Action

Project Design Features and Mitigation Measures

Treatments proposed in each alternative that are adjacent to riparian areas would follow Best Management Practices for water and wetland quality, as well as Forest Plan standards and guidelines for wildlife, fish, soil, and water resources. Refer to the Project Management Requirements Table in the EA for a detailed list of stands requiring specific BMP practices. The proposed treatment types near water bodies are primarily individual tree selection, thinning or shelterwood type harvests in a mix of stands including Northern hardwoods, Red Pine, White Pine, Spruce, and Balsalm fir to promote the health and growth of these stands. Impacts to water quality are negligible from these types of harvests when project designs features are properly implemented and maintained. Stands identified in the project design features where harvest operations would be restricted to frozen ground conditions would not have an impact on water quality (see Soils Specialist report for a complete list of seasonally restricted stands). Selection harvests expose a minimum amount of soil and vegetative cover does not change (Spangenberg and McLennan 1983). Sedimentation would not be expected to occur because equipment operations would not take place a minimum of 15 feet of the ordinary high water mark except on roads or at stream crossings within lakes, designated trout streams and streams 3 feet wide and wider. Wheeled or tracked equipment operation within 15 feet of the ordinary high water mark would occur only when the ground is frozen or dry. For streams less than 3 feet wide and less than 1 foot wide, wheeled or tracked equipment operation within 15 ft. of the ordinary high water mark would only occur during dry or frozen ground conditions. Designated trout streams within the project area include: Fourmile Creek, Kimball Creek, Ninemile Creek, North Branch Pine River and Spring Meadow. There are no aspen stands proposed for clear cut harvest activities within the selected trout stream 300 ft. buffer zones.
At least 60 basal area is required to be left within 100 feet of the high water mark of lakes, designated trout streams and streams 3 feet wide and wider and within 35 feet of streams less than 3 ft. wide. Erosion and sediment yield from timber harvest areas is usually low because ground cover is often provided by residual vegetation, logging slash and rapid re-growth of vegetation (Very 1972; Spangenberg and McLennan 1983). Even when erosion does occur, it frequently is not delivered to waterbodies because of the low relief and undulating terrain which

is quite typical of the project area (Verry 1972). Project design features, which include BMPs and Forest Plan standards and guidelines, when properly implemented would ensure that project activities would *not* cause long term impacts to water quality.
Proposed treatment areas would be monitored during project implementation to ensure contract specifications and design features are followed. The effectiveness of the proposed design features are based upon monitoring results complied from the Wisconsin Department of Natural Resources. During the mid-1990s, the Forests also participated in the development of "Wisconsin's Forestry Best Management Practices for Water Quality" (WDNR 2010) and support their use to minimize sediment and other non-point sources of water pollutants. The use and effectiveness of Best Management Practices (BMP's) across all land ownerships in Wisconsin, including the National Forest, was monitored by interdisciplinary and interagency teams, during the years of 1995 to 2015. BMPs have been applied correctly a vast majority of the time when needed and these have been extremely effective in protecting water quality. The field evaluations indicated that 99.8% percent of the time no adverse impact to water quality occurred when a BMP was applied correctly where needed. The most recent monitoring on Federal and Industrial timber sales was conducted in 2014 where 29 timber sales were monitored throughout the Chequamegon-Nicolet National Forest. Overall BMP application rates on federal lands have significantly improved since the start of the monitoring program. The highest percentage rate of correctly applied BMPs was RMZs at 100%. For a more in-depth analysis of the BMP monitoring results please see Appendix D- *Implementation and Effectiveness of Wisconsin's Forestry Best Management Practices for Water Quality on the Chequamegon-Nicolet National Forest, 1995-2014.* Moreover, according to the 2010 Wisconsin Statewide Forest Assessment the WDNR BMP program is considered a success as studies have shown that silviculture is not a significant source of water quality impairment in Wisconsin (WDNR 2010).

WDNR research division is currently conducting a research project entitled "*Effectiveness of Riparian Management Zone Best Management Practices for Preserving Stream Health in Timber Harvest Areas*". The objective of the study is to determine if there are any meaningful changes to stream habitat, fish assemblages, and macroinvertebrate assemblages after vegetative treatments that utilize Wisconsin BMP's for water quality. Preliminary results suggest that they have not been able to detect significant changes in composite habitat and fish measures after harvesting under existing BMP guidelines (WDNR, 2010). The study is on-going.

In 2012 the Forest Service developed and started implementation of a National BMP program which focuses on being a nationally consistent, systematic and objective approach to BMP monitoring across all of the nation's national forests. The Forest Service is continually monitoring the implementation and effectiveness of BMPs across various land management activities, i.e. ground based harvesting, recreation management, road construction, mining, prescribed burning, etc. (USFS 2015). On the Chequamegon-Nicolet National Forest, ground based skidding and harvesting operations were monitored on six different timber sale units. Results from monitoring rated BMP implementation and effectiveness as 'excellent' (CNNF 2015). In addition, 2014 nationwide monitoring results indicate the highest percentage of 'excellent' and 'good' evaluations were in the mechanical harvesting category. Harvest activities have a long history of emphasis on the use of BMPs to protect water quality (USFS 2015).

Direct and Indirect Effects - Alternative 2

Peak Flow- Snowmelt Runoff

The recommended threshold where peak flows from snowmelt would begin to increase to the point where they could adversely affects stream channels, water quality (i.e., sediment) and aquatic habitat is 60 percent or more of a watershed (Verry 2000). The proposed clear cut harvest activities and amount of existing open area is below the 60% threshold. Impacts to peak flows from snowmelt would be negligible. See table 6 below.

Table 6. Peak Flow from Snowmelt Alternative 2

HUC 6 Watershed	Total Acres	Proposed Clear Cut Harvest Acres	Non-Forest Upland Acres	Non-Forest Wetland Acres	Existing Open Snowmelt (%) *Non-forest Upland +Non Forest Wetland*	Alt. 2 Open Snowmelt (%) CC+ *Non-forest Upland +Non Forest Wetland*
Ninemile Creek-Eagle River	18,292	378	1514	1936	19%	21%
Julia Creek	10,027	209	993	1692	27%	29%

Peak Flow- Rainfall Runoff

A threshold of 35 percent of the watershed would provide reasonable protection from adverse increases in peak storm flows and the percentages found as a results of the proposed clear cut harvest activities are well below the 35% threshold (Verry 2000). See table 7 below.

Table 7. Peak Flow from Rainfall Alternative 2

HUC 6 Watershed	Total Acres	Proposed Clear Cut Harvest Acres	Non-Forest Upland Acres	Existing Open Rainfall (%) *Non-forest Upland*	Alt. 2 Open Rainfall (%) CC+ *Non-forest Upland*
Ninemile Creek-Eagle River	18,292	378	1514	8%	10%
Julia Creek	10,027	209	993	10%	12%

RMZ Vegetation Management

Table 8 below summarizes the total acreage of proposed treatments that are located in RMZs for alternative 2. In the Fourmile project area, there are a total of 7204 acres within the RMZ's. Up to 105 RMZ acres are proposed for treatment in alternative 2. The proposed harvest treatments and associated site preparation activities promote the growth and retention of long lived species appropriate to the site conditions. Riparian areas provide large woody debris for the aquatic and terrestrial portions of the riparian area, soil and bank stability, diverse and productive sites for aquatic and terrestrial plants and animals. Maintaining healthy riparian ecological function provides for macroinvertebrate and fish habitat as well as stable banks and channel morphology for water quality. A detailed list of proposed vegetation treatments in RMZs is summarized by each alternative in Appendix E *Proposed Harvests/Activities in RMZs*.

Table 8. Summary Proposed Activities Located in RMZs for Proposed Action

Proposed Treatment	**Proposed Action**
Stand Clear Cut with site prep and planting	2.9
Argonne research	0.08
Coppice with Aspen site prep (along unnamed lakes, Eagle River)	4.02
Improvement- individual tree selection	6.6
Ladder fuels treatment	4.7
Overstory removal	0.8
Partial overstory removal	1.23
Restoration thin (pine)	2.9
Salvage	0.5
Selection (mixed hardwoods)	29.2
Shelterwood	9.9
Thin (pine)	41.5
Total	**105 acres**

Road Activities in RMZs and Wetlands

There are approximately 10 miles of road adjacent to or are located within wetlands and 21 existing road stream crossings. Activities located in wetlands, RMZs and/or road stream crossings include:

1. PO61629- Decommission undetermined road that crosses Furbush Creek; approximately 0.03 miles would be decommissioned within the RMZ.
2. Construct 4- New construction would cross 103 ft. of wetland. Road would be added to the road system as closed. The stands the road accesses would require frozen ground operation so the wetland crossing could be frozen down for access.
3. 6162104- Temporary access. Road crosses about 1710 feet of wetland in 2 separate locations. Road just south of Julia Lake.
4. FDR2432- reconstruct entire open system road. The road crosses approximately 313 feet of wetland. Reconstruction activities would require two culvert replacements at wetland crossings as well as installing three new culverts to improve road surface drainage.
5. FDR2018- reconstruct road that follows edge of wetland for approximately 262 ft. The road will be reconstructed and then left open.
6. FDR617330- reconstruct road and maintain as ML1 closed road. Road crosses wetlands in 2 locations for a total wetland length of 472 ft. There is an existing road bed present.
7. FDR627146- reconstruct road and maintain as ML1 closed road. Road crosses 2054 ft. of wetland. There is an existing road bed present.
8. FDR62741- reconstruct road and maintain as ML 1 closed road. Road crosses 1034 wetland. Some of the wetland crossings may not be needed.
9. FDR616277-reconstruct road and maintain as ML1 closed road. Road across Scott Creek Impoundment. Road crosses 358 ft. of wetland and crosses Scott Creek impoundment.
10. FDR627410-reconstruct road and maintain as ML1 closed road. Road crosses 78 ft. wetland. There is an existing road bed but will require some work.
11. Temporary stream crossing on Mosquito Creek- utilize temporary bridge to cross stream.
12. There are numerous segments of undetermined roads that will be decommissioned. These roads are typically overgrown or they no longer exist on the landscape. There are 2.33 miles of road within wetlands that would be decommissioned.

All roads recommended for construction or temporary access would be designed with proper cross drainage to maintain hydrologic function across the landscape. All appropriate permits needed from the Army Corps of Engineers and Wisconsin Department of Natural Resources would be obtained prior to construction activities where needed. This may include Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit for storm water discharge.

Table 9. Resource indicators and measures for Alternative 2 direct/indirect effects

Resource Element	Resource Indicator (Quantify if possible)	Measure (Quantify if possible)	Alternative 2 Direct/Indirect Effects	
Peak Flow- Snowmelt Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <15 yrs. old+ non-forest upland+ non-forest wetland)	Julia Creek 29%	Ninemile Creek- ER 21%
Peak Flow- Storm Flow Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <9 yrs. old+ non-forest upland)	Julia Creek 12%	Ninemile Creek- ER 10%
RMZ Vegetation Management	Large Woody Debris future recruitment	Acres of riparian treatments to promote long lived species	105 acres	
Road Activities in RMZs and Wetlands	Sediment delivery	# of stream crossings removed or length of road wetland crossings removed	1 stream crossing removal AND 2.3 mi. wetland road crossing decommissioned AND 0.03 mi. decommissioned in RMZ	

Cumulative Effects – Alternative 2

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

Past, present and reasonably foreseeable clear cut harvest activity acres located within the cumulative effects area for aquatic resources were identified. To simplify data from State, County and private managed forest law and forest crop law harvests the total acreage of all harvest types were identified within the two watersheds used for the peak flow analysis. Clearcut aspen harvests from Forest Service vegetation management projects, Fishel and Early Successional Habitat Improvement, were also identified.

Peak Flow- Snowmelt Runoff and Rainfall Runoff

Snowmelt runoff only increased by 0.4% (16.9 to 17.3%) and rainfall runoff increased by 0.3% (8.2 to 8.5%). A total of 1220 acres was used to calculate snowmelt runoff and 650 acres was used to calculate rainfall runoff. Clear cut activities located in wetlands were eliminated from the rainfall runoff calculation. See table 10 below for a summary of past, present or reasonably foreseeable clear cut harvest activities located within the cumulative effects boundary. Overall, impacts to runoff from snowmelt or rainfall would be negligible as the percentages are well below the threshold.

Table 10. Summary Past, Present and Reasonably Foreseeable Clear Cut Harvest Activities Located in Cumulative Effects Boundary

Clear Cut Species	Source	Acres	
All harvests (harvests <15 yrs. old)	MFL, CFL or State	1220	
Al harvests (harvests <9 yrs.old)	MFL, CFL or State	631	
Aspen CC	FS- ESHI Scott Creek	8.9	
Aspen CC	FS- Fishel	10	
	Total	1220 ac. (snowmelt runoff)	650 ac. (rainfall runoff)

RMZ Vegetation Management

Activities, such as, timber harvesting and road building, have occurred over the past 30 years and were implemented following Land and Resource Management Plan standards and guidelines, site specific design features to mitigate aquatic resource impacts, or contract operating restrictions on Forest Service lands. The Forest has also implemented Wisconsin Forestry BMPs for Water Quality since 1995 and recent field monitoring conducted on Forest Service land indicates that 99.8% of the time there are no adverse impacts to water quality (Kafura and Kreigel, 2015). Comments from monitoring teams observing Forest Service timber sale harvests include: '*sale layout/activities implemented excellent stream protection; where some areas the RMZ was extended to the top of slopes and some RMZs no harvest operations occurred*.' '*RMZ harvest activities also promoted the growth and retention of long lived species*.' '*Sale units also utilized existing roads to minimize additional ground disturbance* (Kafura and Kreigel, 2015).'

Past, present and reasonably foreseeable activities that would occur within the cumulative effects RMZs include 11 acres of commercial thinning located on Forest Service lands. Harvest activities and/or planting activities located on other government or private lands was determined for the entire treatment stand. The RMZ acres were not calculated due to the lack of detail in GIS layers for these land types.

Road Activities in RMZs and Wetlands

Many of the roads within the area have been in place since the early logging era. Over the years, the road mileage has increased but it is still based on roads located during the early logging era. It has contributed to changes in drainage patterns, increased sediment loads, fish passage problems, and loss of riparian habitat (Forest Plan FEIS, p. 3-19 through 3-25). Poorly designed, located, constructed, or maintained roads and trails can be significant sources of stream sediment. Roads and trails with undersized culverts that fail frequently are considered the largest sources of sediment in streams because failure typically produces several tons of sediment and the entire volume is delivered to the stream. The Forest Service along with Townships, Counties and State entities are annually improving road stream crossing sites or road drainage problems as part of their annual maintenance program. This type of work is also occurring on recreational trails.

Table 11. Resource indicators and measures for alternative 2 cumulative effects

Resource Element	Resource Indicator (Quantify if possible)	Measure (Quantify if possible)	Alternative 2 Cumulative Effects	
Peak Flow- Snowmelt Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <15 yrs. old+ non-forest upland+ non-forest wetland)	Julia Creek 34%	Ninemile Creek- ER 25%
Peak Flow- Storm Flow Runoff	Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (forest <9 yrs. old+ non-forest upland)	Julia Creek 14%	Ninemile Creek- ER 12%
RMZ Vegetation Management	Large Woody Debris future recruitment	Acres of riparian treatments to promote long lived species	105 acres +5.5 acres thinning	
Road Activities in RMZs and Wetlands	Sediment delivery	# of stream crossings removed or length of road wetland crossings removed	1 stream crossing removal AND 2.33 mi. wetland road crossing decommissioned AND 0.03 mi. decommissioned in RMZ	

Summary

Degree to Which the Purpose and Need for Action is Met

Table 12. Summary comparison of how the alternatives address the purpose and need

Purpose and Need	Indicator/Measure	Alt 1	Alt 2
Need to improve/maintain forest health	Acres of riparian treatments to promote growth and retention of long lived species	0	105

Degree to Which the Alternatives Address the Issues

Table 13: Summary comparison of how the alternatives address the key issues

Issue	Indicator/Measure	Alt 1		Alt 2	
Peak Flow Snowmelt Runoff- Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (>60% of watershed exceeds threshold)	Julia Creek 27%	Ninemile Creek- ER 19%	Julia Creek 29%	Ninemile Creek- ER 21%
Peak Flow- Storm Flow Runoff- Sediment delivery and Stream Channel Morphology	% of watershed in open landscape condition (>35% of watershed exceeds threshold)	Julia Creek 10%	Ninemile Creek- ER 8%	Julia Creek 12%	Ninemile Creek- ER 10%
Sediment delivery from Road Activities	# of stream crossings removed or length of road wetland crossings removed	0		1 stream crossing removal AND 2.33 mi. wetland road crossing decommissioned AND 0.03 mi. decommissioned in RMZ	

Summary of Environmental Effects

Timber harvest treatments proposed in alternative 2 and that are adjacent to riparian areas would follow Best Management Practices for water quality, as well as Forest Plan standards and guidelines for wildlife, fish, soil, and water resources. BMPs when properly implemented would ensure that project activities would *not* cause long term impacts to water quality. During harvest operations stands would be monitored on a regular basis to ensure project design features are implemented and maintained. All of the project design features, when properly implemented and maintained, would ensure that project activities would *not* impair water quality.

As a result of the proposed clear cut harvest activities for Alternative 2 there would be no impacts from snowmelt runoff or rainfall runoff as the open area throughout the watersheds would not reach the thresholds.

Harvest activities proposed in Alternative 2 would promote the long term health of riparian areas as stand treatments would promote the growth and retention of long lived species. In some of the stands where natural regeneration may be difficult, riparian underplanting of long lived species would be an associated treatment for those select stands. There are no aspen stands proposed for clear cut harvest activities within the selected trout stream 300 ft. buffer zones. Alternative 2 would help the Eagle River/Florence Ranger District move in the direction to meet Forest plan goals and objectives.

Decommissioning 2.33 miles of road located within wetlands, 0.03 miles of road in RMZs and decommissioning 1 stream crossing in alternative 2 would help to improve hydrologic functions by restoring cross drainage and reducing sediment inputs. The elimination of these road segments would help the Forest achieve Objective 1.3d to relocate, in this case eliminate,

existing roads and trails out of Riparian Management Zones to minimize erosion, sedimentation, and hydrologic impacts.

An objection on the Draft Decision for the project made by the Environmental Law and Policy Center, et al. (ELPC) raised the following issue: *The EA/draft FONSI do not address the scientific literature that would suggest that the Project may well have a greater negative impact on water resources than the EA/FONSI acknowledge. Clearcutting in the Riparian Management Zone Will Impact Water Quality.* An analysis by the team of Forest Service resource professionals concluded: Aspen within RMZs is discussed in the Aquatics specialist report and addressed with the design features. However, this stand-specific information is missing from the EA/draft FONSI Appendix A. In response to the issue, updates to the Fourmile EA/draft FONSI Appendix A were made. In addition, there are **no** aspen stands located within the selected trout streams (as listed in Appendix DD of the LRMP) proposed for clear cut harvest activities. The selected trout streams where aspen will not be regenerated within 300 feet are listed in the Aquatics Specialist report's Appendix A, *Fourmile Existing Condition*. There are **no** aspen stands proposed for clear cut harvest activities within those 300 ft. buffer zones.

Compliance with LRMP and Other Relevant Laws, Regulations, Policies and Plans

All of the proposed alternatives are consistent with the CNNF LRMP 2004. In addition, all of the proposed alternatives are consistent with the Federal Laws, Executive orders, state of Wisconsin Department of Natural Resources administrative codes and Forest Service policy referenced in the regulatory framework section above (pgs. 7-13).

Other Relevant Mandatory Disclosures

Intensity Factors for Significance (FONSI) (40 CFR 1508.27(b))

The North Branch Pine River which is a state of Wisconsin designated Wild River is located in the project area. The alternatives do not have effects on these resources as described in Chapter 3 of the EA.

Glossary

Riparian Ecosystems- The transitional area between the aquatic ecosystem and the adjacent terrestrial ecosystem. It is identified by soil characteristics and distinctive vegetation communities that require free or unbound water (FSM 2526.05 page 18).

Aquatic Ecosystems-The stream channel, lake, or estuary bed, biotic communities, and habitat features that occur therein (FSM 2526.05 page 18).

Wetlands- Areas that are inundated by surface or ground water with frequency sufficient to support, under normal circumstances, vegetation or aquatic life that requires saturated or seasonally saturated, soil conditions for growth and reproduction (FSM 2527.05 page 23).

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Appendices

A- Existing Condition of the Water Features with the Fourmile Project

B- Map of 6th Level HUC Watersheds- Fourmile

C- Map of Surface Water Features- Fourmile

D- Implementation and Effectiveness of Wisconsin's Forestry Best Management Practices for Water Quality on the Chequamgeon-Nicolet National Forest, 1995- 2014

E- Table of Proposed Harvest Activities in Riparian Management Zones

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